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Roof Fall Entrapment Exercise

Instructor's Copy

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This latent image exercise was developed and field tested under U. S. Bureau of Mines research Contract No. HO348040. Information about the design and characteristics of the exercise and the field test results are available in the project technical reports filed with the Bureau of Mines Research Center in Pittsburgh, PA. This is one of more than 30 exercises designed for use in annual refresher training to teach and test critical skills for coping with mine emergency situations. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies or recommendations of the Interior Department's Bureau of Mines or the U. S. Government.

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Appendices

Appendix A: Problem booklet (duplicate this copy for use in class)

Appendix B: Answer sheet blank (print the latent image answers on this)

Appendix C: Latent image answers (print these on the answer sheet)

Introduction

This document contains most of the materials needed to use the exercise. The main part of the document is the instructor's copy. It tells how to use the exercise, presents the objectives, the master answer sheet, the scoring key, and discussion notes to be used following the exercise. The next section summarizes results from field tests of the exercise, and reports the miners' evaluation of the activity. The last part of this document is three appendices. Appendix A is the exercise problem booklet. This booklet can be duplicated locally. The booklets are reusable. One is needed for every person in the classroom. Appendix B is the answer sheet and the trainee's questionnaire. Copies of this answer sheet must have the latent image (invisible) ink answers that appear in Appendix C printed on them.[1] Answer sheets are consumable. One is needed for each person or each small group of persons who work the exercise.

Exercise Summary

Read this section first. It determines if the exercise is appropriate for your classes. If you choose to use the exercise, examine the table of contents and review the remainder of this document.

Type: Latent Image

Length: Nine questions (20 minutes for administration plus 30 for discussion)

Skills: Recalling pillar extraction and ground control procedures
Recognizing signs of unstable roof
Locating a safe waiting place after being trapped in an entry by a roof fall
Waiting for rescue and taking constructive action to prevent injury to yourself and/or the rescuers
Communicating with the rescuers while trapped

Location: Underground

Problem: A group of miners are extracting pillars in an unsafe manner. There is only one escapeway from the area where they are working. Earlier falls have blocked the other escapeways. The top is bad in the entry being used for the haul road. The posts and crossbars that support the top at the intersection of a crosscut begin to sag so much that the shuttle car you are driving can't come out from the face. The foreman yells to you to tell the miners to get out. But it is too late! As you are about to come out there is a large roof fall that completely blocks the one escapeway. You and the other miners are lucky. No one is hurt. But now you have to decide what to do.

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[1] You can do this yourself if you have the proper equipment, or you may wish to purchase copies of preprinted latent image answer sheets from the University of Kentucky, IMMR, 234 Mining and Minerals Resources Building, Lexington, KY 40506, (606) 257-8636, or the National Mine Health and Safety Academy, P.O. Box 1166, Beckley, WV 25802, (304) 255-0451.

HOW TO USE THIS EXERCISE

1. Look at the performance objectives. Decide if the exercise is relevant for your annual refresher class.

2. Work through the exercise with the special pen and score your responses.

3. Read the master answer sheet for the exercise. Look at all the answers.

4. Read the "Instructor's Discussion Notes" for the exercise.

5. Become thoroughly familiar with the problem so that you can present it to your class without reading it. Put the maps or illustrations on an overhead projector so you can use these to help explain the problem.

6. When you present the exercise to the class:

   - Explain that the answers from class members will be used to improve the exercise in the future.

   - Give each person an exercise booklet, an answer sheet and a pen.

   - Demonstrate how to select and mark answers using the special pen.

   - Go over the instructions for doing the exercise with the whole group.

   - Explain the problem making sure everyone understands the problem situation.

   - Have the class members work the exercise.

   - When the class members finish, have them figure up their score using the instructions at the end of the exercise.

   - When everyone has finished, discuss the exercise. Let class members discuss the merits of each answer. Add your own ideas. Then have each person fill out the Trainee's Questionnaire attached to the answer sheet.

   - After class look over the completed trainee's questionnaires and the answer sheets. This information may provide ideas for improving the exercise for future classes. Write out your ideas for improving the exercise and send them to the following address.

IMMR/BRASH
201 Porter Building, University of Kentucky
Lexington, Kentucky 40506-0205 ph. (606) 257-3796

Performance Objectives for Roof Fall Entrapment Exercise

Objective number	Capability verb(s)	Description of required performance and conditions under which it is to occur
1 GC*	Recall	Appropriate times to check roof conditions
2 EE	Recognize	The danger of attempting to move a fall without proper roof support
3 EE/ GC	Recognize Select	The safest location to await rescue when entrapped behind a roof fall
4 EE	Recall Select	Signaling procedures for an entrapment situation
5 EE	Recognize Select Order	Procedures for reporting and beginning rescue procedures during an entrapment accident
6 EE/GC	Identify Recognize	Cues that indicate an impending roof fall
7 EE/GC	Identify Recognize	Proper and improper practices for roof control during pillar extraction
8 EE/GC	Recall Identify List	Ground control and mine conditions that prohibit pillar extraction because of threats to miners' safety

*Skill and knowledge domain abbreviations:
GC = ground control
ΞE = emergency evacuation and escape

Master Answer Sheet for Roof Fall Entrapment Exercise

Use this answer sheet to mark your selections. Rub the special pen gently and smoothly between the brackets. Don't scrub the pen or the message may blur. Be sure to color in the entire message once you make a selection. Otherwise you may not get the information you need.

Question A (Select as MANY as you think are correct)

1. [Correct! Everyone says that they are OK.]

2. [Correct! You yell to him and can barely hear him say that he will get you out.]

3. [You should not split up or leave this area now.]

4. [It would be dangerous to try to move the fall. Air is not a major concern at this]
   [time.]

5. [There are things you should be doing now.]

6. [Correct! The top appears to be good nearly all the way up to the E6-C39]
   [intersection. It is still working near the fall.]

Question B (Choose only ONE unless directed to "Try again!")

7. [The top over the fall is not supported and is still working. This would be very]
   [dangerous. Try again!]

8. [Correct! This should be done as soon as possible in the safest area. Do next]
   [question.]

9. [The power to the miner has been cut by the fall. Anyway, this could be]
   [dangerous. Try again!]

10. [You should try to calm Jimmy and keep him away from the fall area. Try]
    [again!]

Question C (Choose only ONE unless directed to "Try again!")

11. [This area is inside an incomplete pillar. It is not safe. Try again!]
    [ ]

12. [Correct! This is the safest place because it is between the two most complete]
    [pillars. Do next question.]

Question C (continued)

13. [Position C is not safe. The incomplete pillars make this area unstable. Try again!]

14. [The split pillar on the left, and the cut pillar on the right, make this area unstable. Try again!]

Question D (Choose only ONE unless directed to "Try again!")

15. [This is dangerous. The top is still working near the fall. Try again!]

16. [Air would not be a major concern in this large an area. There is something else you should be doing. Try again!]

17. [Correct! You need to stay under the extra support. The top is weak. Jimmy is upset. You should keep an eye on him. Do next question.]

18. [Pounding the top could possibly cause another fall. The top is weak. Anyway, the others know where you are. Try again!]

Question E (Choose only ONE unless directed to "Try again!")

19. [There is something else he should have done first. Try again!]

20. [Correct! He should have immediately called for help and equipment, including first aid supplies. Do next question.]

21. [He should have done something else. Try again!]

22. [This is dangerous. He might have been killed and been of no help to the others. Try again!]

Question F (Choose only ONE unless directed to "Try again!")

23. [There is something else he should have done. Try again!]

24. [This is dangerous. Try again!]

25. [This is risky. Try again!]

26. [The help he sent for will arrive at today's fall. Try again!]

Question F (continued)

27. [Correct! It is wise to plan, gather materials, talk to the trapped miners, and not]
[try to support the bad top until help arrives. Do next question.]

Question G (Choose only ONE unless directed to "Try again!")

28. [This is not safe. Try again!]

29. [This area is not safe. Anyway, help is on the way to position B. The foreman]
[has told the others where you are. Try again!]

30. [Correct! Soon you hear rock being moved. Do next question.]

31. [This is dangerous. There is less pillar support at position E than at position B.]
[Try again!]

Question H (Choose only ONE unless directed to "Try again!")

32. [This is dangerous. Try again!]
[ ]

33. [This is dangerous. Try again!]
[ ]

34. [You should not remove these timbers. The falls may have made this area]
[unstable. Try again!]

35. [Correct! You should stay at position B until the way out is made safe. It is]
[important to talk with the rescuers while you wait. Do next question.]

Question I

List all the unsafe mining practices and violations of state and federal laws that occurred in this problem.

_____

_____

_____

_____

END OF PROBLEM

Finding your score

Number of "Correct" answers you colored in = (1) _____

25 minus number of incorrect answers you colored in = (2) _____

Add blanks one and two to get your total score = (3) _____

Highest possible score = 35

Lowest possible score = 0

TRAINEE'S QUESTIONNAIRE

1) name of exercise _____

2) your age _____ 3) your sex _____ M _____ F 4) years underground coal miner _____

5) your job title _____

Check all the areas in which you have special training, certification, and/or that you routinely perform.

	Special Training	Certification	Routinely Perform
6) Mine Foreman	_____	_____	_____
7) Mine Safety Committee	_____	_____	_____
8) Mine rescue	_____	_____	_____
9) CPR	_____	_____	_____
10) Advanced first aid	_____	_____	_____
11) EMT	_____	_____	_____
12) Advanced life support	_____	_____	_____
13) Other (describe) _____	_____	_____	_____

Think about the exercise you just finished. Circle the number which tells how much you agree or disagree with the following statements.

	Definitely Yes			Definitely No
14) This problem could happen in real life.	4	3	2	1
15) This exercise will help me remember something important if I am ever in a similar situation.	4	3	2	1
16) I learned something new from the exercise.	4	3	2	1
17) The exercise took too long to complete.	4	3	2	1
18) I liked working the exercise.	4	3	2	1
19) The instructor's directions were clear.	4	3	2	1
20) The written directions in the exercise were easy to understand.	4	3	2	1
21) The diagrams, charts, and pictures were easy to understand.	4	3	2	1
22) The scoring procedures were easy to understand.	4	3	2	1
23) The exercise was easy to read.	4	3	2	1

If you have anything more to say about the exercise, please write on the back of this page. Thank you.

Instructor's Discussion Notes for Roof Fall Entrapment Exercise

Use the information presented here and on the master answer sheet, your own ideas and experience, and those of the miners in your class to discuss the exercise after it is completed. Group discussion can help strengthen knowledge and skills, correct errors, and relate the exercise content to the experiences of the miners. After they have worked the exercise, miners enjoy discussing the problem. They also frequently think of better ways to respond to a problem than those listed among the answers. The purpose of the exercise is to help miners think about and remember basic knowledge and skills they may someday need to deal with a mine emergency. The discussion following the exercise can contribute to this goal and tailor the exercise content to the needs of the group.

It is helpful to show overhead transparencies of the answers on the master answer sheet during the discussion, while the miners look at their problem booklets. This allows you to lead the group through the exercise and to discuss all the answers to each question. Most of the information about why particular answers are correct or incorrect is given on the master answer sheet.

The following notes provide additional information for you to discuss with your class. Read through and think about the notes before the class. Don't read the notes to the class members. This would be boring and ineffective. Rather, incorporate the ideas you find here with your own ideas and make these points at the appropriate place in the discussion of the exercise.

Question A - The correct answers are 1, 2, and 6. After a roof fall has occurred, miners trapped behind that fall should 1) check the top to determine the safety of their positions, 2) check to see if anyone has been hurt, and 3) attempt to communicate with someone outby the fall. Miners should not split up in a situation like this one. Moving the fall also should not be attempted. This activity could expose the miners to a second roof fall. In an area this large the air supply would not be a major concern. The top near the fall is the most immediate danger.

Question B - The correct answer is 8. Although just sitting and waiting may be difficult, it is the safest thing to do. The trapped miners know that someone outby the fall knows their location. Any attempt to go near the fall, where the top is working, would be dangerous. The safest place to wait (the area with the most pillar support) should be selected. Then extra support should be added if at all possible.

Question C - The correct answer is 12. The safest place to be when there is a ground control problem is usually between complete pillars. These pillars are the best form of support. Incomplete pillars make the area around them unstable.

Question D - The correct answer is 17. Sitting and waiting for rescue is the safest thing to do in this situation. Talking may help calm a miner who is too upset to think clearly. What should and should not be done can be discussed. Signaling is not necessary at

this point because the foreman knows the location of the trapped miners, and because he can hear them and they can hear him.

Question E - The correct answer is 20. When an accident occurs it should be immediately reported to the outside. Rescue operations can best be coordinated from there. An individual should never begin rescue procedures without asking for help first. In this case, another fall of roof could kill or injure the foreman, making him incapable of calling for help and delaying rescue of the trapped miners.

Question F - The correct answer is 27. The forman should gather roof support materials, talk to the trapped miners to keep them informed, and plan the best way to support the top. Because the area is unstable and the top is weak, he should not begin supporting the roof until help arrives. He could be injured or killed in a second fall. He is the only one who knows the details and conditions of the trapped miners. He is also at the scene and in the best position to make an assessment of what is needed to support the roof and rescue the trapped miners. Stopping to think and plan is important. The time he spends planning while the others arrive will not be wasted.

Question G - The correct answer is 30. Even if communication is lost, signaling is not necessary if the entrapped miners know that their location has been reported. In this situation, it would be unwise to pound on the top, rib, bottom, or posts. The area is unstable.

Question H - The correct answer is 35. The entrapped miners should wait until their rescuers create a safe escapeway. Roof support needs to be added through and inby the fall to create the escapeway. Waiting is difficult but the miners should not put themselves in a dangerous position, (under unsupported top) while escaping. The trapped miners should watch carefully as the rescue team comes through the roof fall. Rescuers are sometimes prone to rush in to see if the trapped miners are all right. The trapped miners should watch the top on their side of the fall and warn the rescuers if there is any dribbling or other signs of weak top.

Question I - Some of the violations and poor practices include:

- Failure to file and/or to follow a proper roof control plan for pillar extraction (CFR 75.200-11);
- Cutting pillars on more than one side of the mining crew, and working inby cut pillars (CFR 72-201(h));
- Inadequate examination of escapeways and the working area (CFR 75.1704-2);
- Working in an area with only one escapeway when the top is known to be bad;
- Insufficient number of breaker posts, turn posts, and roadway supports (CFR 75.200-11(c),(e), and (f));

- Possible inadequate plan for, inadequate supervision of, and inexperienced miners involved in roof support for pillar recovery (CFR 75.200-14);

- Possible inadequate ventilation of the working face during pillar extraction (CFR 75.328).

References

Moody, Geralt F. (1979). Report of investigation (underground coal mine) entrapment. Mine I. D. No. 36-00906, Green County, PA, Monroeville, PA: MSHA, District 2, Subdistrict Office.

Office of the Federal Register. (July 1984). Code of Federal Regulations, Title 30 (Part 75). Washington, DC: U.S. Government Printing Office.

Scoring Key for Roof Fall Entrapment Exercise

Question A

1. ___R___
2. ___R___
3. ___W___
4. ___W___
5. ___W___
6. ___R___

Question B

7. ___W___
8. ___R___
9. ___W___
10. ___W___

Question C

11. ___W___
12. ___R___
13. ___W___
14. ___W___

Question D

15. ___W___
16. ___W___
17. ___R___
18. ___W___

Question E

19. ___W___
20. ___R___
21. ___W___
22. ___W___

Question F

23. ___W___
24. ___W___
25. ___W___
26. ___W___
27. ___R___

Question G

28. ___W___
29. ___W___
30. ___R___
31. ___W___

Question H

32. ___W___
33. ___W___
34. ___W___
35. ___R___

Summary of Field Test Results

The Roof Fall Entrapment Exercise (RFE) underwent two rounds of field testing, including authentication and one field test. The authentication consisted of a small initial field test that produced too little data for meaningful statistical summaries, but many comments, criticism, and suggestions that were used to revise and improve the exercise before the formal field test. The formal field test involved carefully controlled administration of the revised exercise to groups of miners at multiple sites. Tables that summarize the results of the field test for RFE1 are attached. The version of the exercise included in this document includes all of the cumulative revisions made as a result of both rounds of field tests.

RFE1 was field tested with 91 miners, in 5 classes, at 4 sites. One set of tables is attached for the field test results of RFE1. The set of tables is divided into two parts. The first part describes the people who participated in the field test and their evaluation of the exercise. The second part describes the measurement properties of the exercise.

Sample characteristics and miners' evaluations

Tables 1 through 3 describe demographic characteristics of the sample. Table 4 indicates the number of persons in the sample who reported either some training, special certification, and/or routine performance of the eight areas listed as rows in the table. Inspection of these tables quickly reveals the numbers and types of persons involved in the field test of the exercise.

Table 5 reports the miners' judgment of the exercise quality and worth. Each person was asked to rate the value of the exercise on each of ten qualities. By checking a number on a scale, miners indicated to what extent the exercise displayed each quality. Inspection of the values in Table 5 reveals the percentage of miners who reported that the exercise 1) was realistic, 2) helped them to remember important things, 3) helped them learn something new, 4) was too long, 5) was enjoyable, 6) instructor's directions were clear, 7) written directions were clear, 8) illustrations and maps were clear, 9) scoring procedures were easy to understand, and 10) was easy to read.

Psychometric properties

The next set of tables describe the psychometric (mental performance measurement) properties of the exercise. Table 6 presents summary data for each of the exercise questions, including the minimum, maximum, median, and mean question scores observed in the sample; the standard deviation and skewness of each question score; the squared correlation coefficient of each individual question score with the exercise total score; and the estimated reliability of the total exercise score if that particular question were dropped from the test. The last line in Table 6 reports the same information for the total exercise score. This is obtained by summing question scores

across the whole exercise. Each question is weighted such that a perfect score on each question sums to 100 for the exercise total score. Inspection of the table quickly presents the basic performance data for the sample.

The weighting of each question score to produce a total score of 100 is designed to allow comparison of the difficulty of different versions of the same exercise, or different exercises, even though these often have different numbers of questions. The total score of 100 is also a common convention for reporting test scores.

Table 7 reports the number of answers (options) to questions that discriminated properly between persons with high scores on the test and those persons with low scores. Tests that have multiple choice answers to questions must include some incorrect and some correct answers. The person who takes the test must choose among correct and incorrect answers (distractors) to each question. Persons who get a high total score on the test know more about the test content than persons who get low scores. Therefore, when data are aggregated from the whole sample of persons who took the test, wrong answers (distractors) to each question on the test should be significantly negatively correlated with the overall test score, and correct answers to questions should be significantly positively correlated with the exercise total score. When correct answers and wrong answers (distractors) behave this way, the answer (whether correct or incorrect) is said to positively discriminate between persons who know much about the content and those who know little. However, when persons who get high scores on the total test tend to pick wrong answers (distractors) more frequently than persons who get low scores, the answer is said to reverse or negatively discriminate. The opposite case is also true. That is, when persons who get low scores on the total test score tend to pick a right answer to a question more frequently than persons who had high total test scores, that answer is also said to reverse or negatively discriminate. The discrimination values are used to identify and correct problems in the answers for questions. To be valid, the method requires an adequate sample of persons who exhibit a wide range of variability in their total test scores.

Table 7 reports the frequency with which answers to questions behaved in this desirable way. The table tells the percentage of answers to questions on the test that discriminated positively, negatively, or not at all among the ability levels represented in the field test sample.

Another way to look at the discrimination capability of a test is to divide the sample into groups of persons with greater or lesser levels of expertise. Table 8 reports the degree to which the exercise total score discriminated between persons in the sample with different levels of self-reported mine rescue and other technical mine training. The means and standard deviations for these two groups are given as well as the F ratio and the p value.

Finally, the last table is another discrimination analysis for the total exercise score, this time between the self-reported major job categories represented in the sample. The category "miners" includes all working miners that are not supervisors, surveyors, engineers, etc. The "maintenance/technical" category includes all inspectors,

engineers, surveyors, electricians, mechanics, and other technical and maintenance personnel who work in the mines and typically have special skills, and who move from section to section as they complete their work. The "supervisory/management" category includes all managers from the mine section foreman on up. The "other" category includes all other persons such as preparation plant and surface mine workers, personnel, office staff, and others who are not miners but who often participate in annual refresher training classes.

The number of miners reported in the tables varies. This is because not all miners answered all of the questions on the trainee's questionnaire. Also, some of the data received from the field tests reflect individual performances, while other data reflect small group performance. Instructors often had the miners work the exericse in small groups. This is a good instructional procedure that miners enjoy. However, the psychometric studies require individual exercise administration in order to carry out the discrimination analyses. Therefore, Tables 1 through 5 report the actual or valid percent of persons who responded to specific items on the trainee's questionnaire. The remainder of the psychometric tables report data for the number of persons who properly completed the exercise individually.

Characteristics of the RFE Exercise

The exercise is sound. Miners who completed the exercise judged it favorably. RFE1 did not discriminate between those persons with advanced and basic levels of training in mine rescue or other technical areas of mining. However, this may be because of the lack of sufficient variation in level of training found in the sample. In addition, the exercise deals with basic levels of skill and knowledge that all miners should know. Over fifty percent of the sample reported advanced technical training. These factors combine to produce a high total mean score with a small standard deviation. It is also difficult to interprete the statistics because 11 of the people in the sample reported no underground coal mining experience. While a few of these persons were surface miners with no undergound experience, most were underground salt miners. These demographic characteristics of the sample put individuals into conflicting categories. For example, a salt miner with 15 years of experience would be put into the same category as a surface miner who has no underground experience. These problems with the sample probably account for the lack of discrimination found in Tables 8 and 9.

The mean score on RFE1 was 91.7 with a standard deviation of 9.71. Table 7 shows that none of the answers discriminate negatively with the total score. The exercise is moderately easy for most miners. However, a number of miners make errors in critical skills that should be learned to perfection. Miners and trainers report the exercise is useful in teaching and reinforcing these critical skills.

Characteristics of the field test sample for RFE1 Exercise
(4 sites, 5 classes, n = 91)

Table 1: Age and experience of miners (years)

	n	mode	mean	s.d.
age	90	39	40.9	8.41
experience	85	0*	11.7	7.78

Table 2: Gender distribution (%)

	n	frequency %
female	0	0.0
male	90	100.0

Table 3: Job classification

	n	frequency %
miner	14	17.5
maintenance/technical	19	23.7
supervisory/management	42	52.5
other	5	6.3

Table 4: Self-reported level of expertise (frequency %)

category	training	certification	performance
foreman	24.2	52.7	6.6
mine safety committee	13.2	4.4	5.5
mine rescue	22.0	12.1	9.9
CPR	34.1	31.9	5.5
advanced first aid	33.0	25.3	11.0
EMT	17.6	18.7	6.6
advanced life support	5.5	2.2	6.6
other	9.9	9.9	12.1

*A number of these miners were experienced underground salt miners. The question asked them to list their years experience as underground coal miners. Therefore they reported zero years. This fact explains the modal score of zero.

Table 5: Miners' rating of exercise validity, relevance, quality, and utility (frequency %)

content	definitely yes			definitely no	mean	s.d.
	4	3	2	1		
problem could happen	72.2	17.8	8.9	1.1	3.6	0.70
help remember important things	57.8	32.2	10.0	0.0	3.5	0.67
learned something new	32.6	29.2	21.3	16.9	2.8	1.09
exercise too long	4.4	3.3	12.1	80.2	1.3	0.74
liked working the exercise	65.9	27.5	5.5	1.1	3.6	0.65
instructor's directions clear	79.1	19.8	1.1	0.0	3.8	0.44
written exercise directions clear	75.6	21.1	3.3	0.0	3.7	0.52
graphics easy to understand	73.3	23.3	2.2	1.1	3.7	0.57
scoring easy to understand	72.1	25.6	2.3	0.0	3.7	0.51
exercise easy to read	78.7	20.2	1.1	0.0	3.8	0.45

Psychometric properties of RFE1 Exercise

(printout date 6/10/87, 4 sites, 4 classes, n = 68)

Table 6: Question score and total score statistics

question	minimum score*	maximum score*	median	mean	s.d.	skewness	R^2_{QT}	alpha if question deleted
A	4.2	12.5	10.4	10.1	2.07	-0.77	0.12	0.75
B	3.1	12.5	12.5	12.0	1.81	-4.25	0.39	0.69
C	3.1	12.5	12.5	10.8	2.61	-1.31	0.28	0.72
D	0.0	12.5	12.5	11.2	2.49	-2.40	0.15	0.75
E	3.1	12.5	12.5	11.7	1.92	-2.57	0.40	0.70
F	2.5	12.5	12.5	11.6	2.24	-3.24	0.35	0.71
G	3.1	12.5	12.5	12.0	1.46	-4.17	0.46	0.69
H	3.1	12.5	12.5	12.2	1.34	-5.32	0.53	0.69
Total	27.5	100.0	93.8	91.7	9.71	-4.58	(alpha = 0.78)	

*The values reported are the minimum and maximum scores observed, for this sample. The lowest possible score = 0 and the highest possible score = 12.5. When scores are summed across questions the highest possible score = 100 and the lowest possible score = 0.

Table 7: Proportion of answers discriminating positively, negatively; and not at all with exercise total score ($p<.10$)

positive	negative	no relationship
26/35 (74.3%)	0/35 (0.0%)	9/35 (25.7%)

Table 8: Discrimination between basic and advanced levels of mine rescue/technical training

	n	mean	s.d.	F ratio	p value
basic	27	90.6	13.8	0.49	0.49
advanced	41	92.3	5.8		

Table 9: Discrimination between job categories

	n	mean	s.d.	F ratio	p value
miner	14	94.6	4.0	1.10	0.36
main/tech	13	93.6	5.7		
super/mgt	27	91.5	6.7		
other	5	91.4	3.6		

Appendix A: Problem Booklet

Duplicate this copy of the problem booklet for use in your classes. Each person in your class should have a problem booklet while they are working the exercise. The problem booklets are reusable. To save effort and money, ask the trainees to avoid marking in the booklets and collect all the booklets after the class.

You may obtain copies of the problem booklet from the University of Kentucky or the National Mine Health and Safety Academy. The addresses and telephone numbers for these two agencies are listed in the footnote on page three of this document.

Roof Fall Entrapment Exercise

Problem Booklet

Behavioral Research Aspects of Safety
and Health Group (BRASH)
Institute for Mining and Minerals Research (IMMR)
University of Kentucky, Lexington, Kentucky[1]

August 1987

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[1] This latent image exercise was developed and field tested under U. S. Bureau of Mines research Contract No. HO348040 with the Bureau of Mines Research Center in Pittsburgh, PA. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies or recommendations of the Interior Department's Bureau of Mines or the U. S. Government.

Instructions

Read the problem situation described on the next page. Study the maps until you understand the location of the miners and equipment in the problem. Next, answer each of the 9 questions. Do them one at a time. Don't jump ahead, but you may look back to earlier questions and answers. For the first question, select all of the answers that you think are correct. For the rest of the questions, choose only one answer unless you are directed to "Try again!"

After you have selected a choice to a question, look up its number on the answer sheet. Select your answer to each question by rubbing the special pen between the brackets on the answer sheet. A hidden message will appear and tell you if you are right. When you have finished, you will learn how to score your performance.

Roof Fall Entrapment Exercise

Background

A continuous miner is being used in a 78 inch (6.5 ft) seam.
Pillars are being recovered.
It is near the end of the shift.
The preshift examiner for the second shift will soon be on the section.
Three unplanned roof falls have occurred on this section.
Times and locations of roof falls are shown in Figure 1.

Problem

You are a shuttle car operator. The preshift examiner reported that the posts in the intersection of the number 6 entry (E6) and crosscut number 39 (C39) were bent. At the beginning of your shift, more posts were added and crossbars were installed. Since then, the shift has gone as usual.

You are tramming out your loaded car and find that it won't fit under the new crossbars. (It cleared the bars easily before.) You see that the roof is working in the intersection.

The foreman is outby the intersection. You yell to him that the top is working. He instructs you to go and tell the other miners to come out, while he stays to watch the roof conditions. You return to the face in your shuttle car and tell everyone that the boss says to get out.

After studying the map on page 3, turn the page and answer the first question.

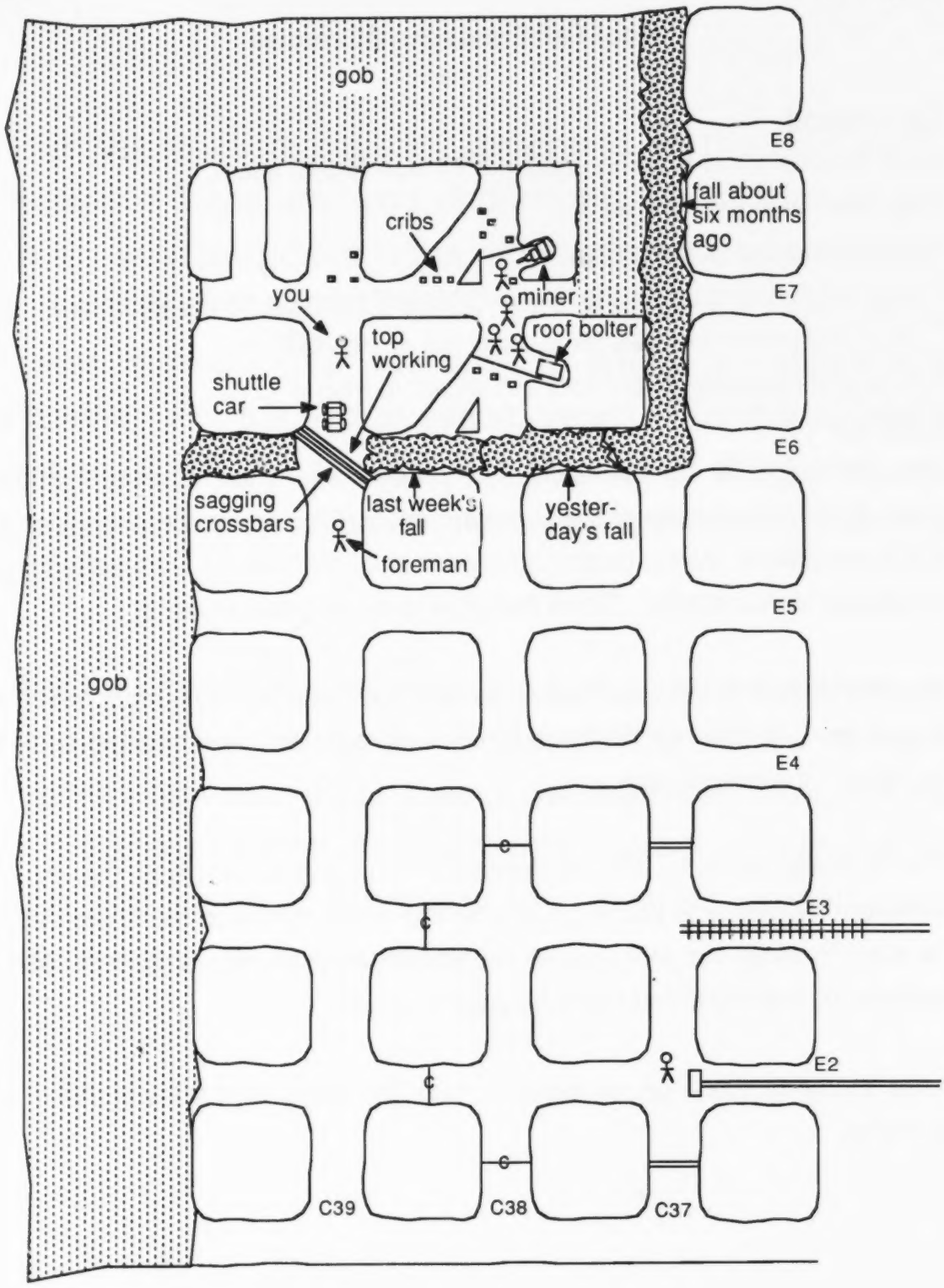

Figure 1: Intersection of 6 entry and crosscut 39

Question A

As you and the other miners are coming out, a fall occurs at the intersection of #6 entry and crosscut 39. (See Figure 2.) The fall has blocked the entire intersection and trapped you and the other miners behind it. You can faintly hear the foreman yelling to you. What should you do? (Select as MANY as you think are correct.)

1. Check to see if the other four miners with you are OK.
2. Yell back to the foreman.
3. Split up and go look for another way out.
4. Try to move the fall so that you can escape before your air runs out.
5. Sit quietly and wait to be rescued.
6. Check the top.

WHEN YOU HAVE MADE YOUR SELECTION(S) DO THE NEXT QUESTION.

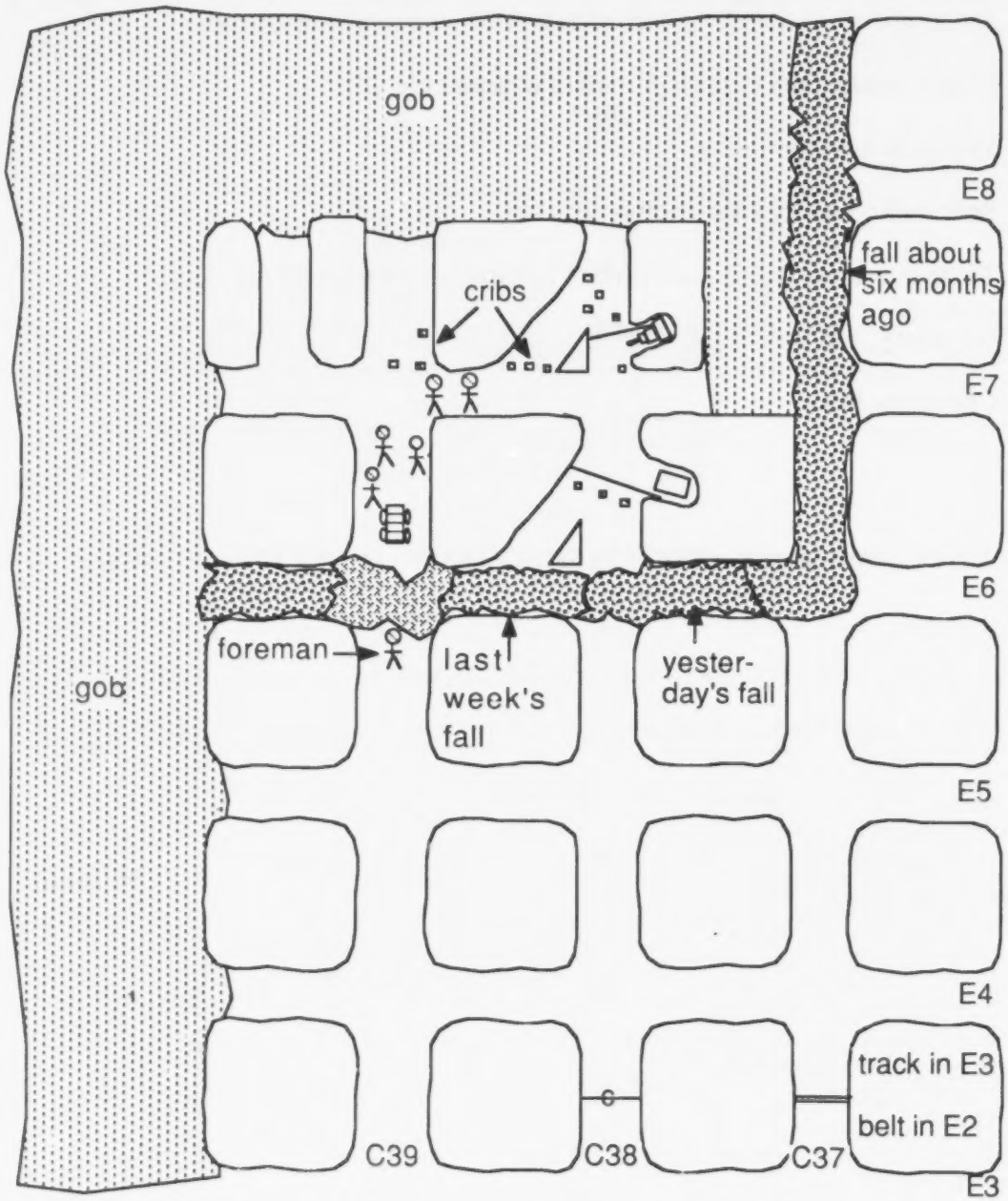

Figure 2: Roof fall in intersection of #6 entry and crosscut 39

Question B

You and the other four miners talk about the situation and come up with some ideas about what you should do. Which is the best idea? (Choose only ONE unless directed to "Try again!")

7. Mac wants to climb over the fall to see if he can get out.

8. The timberman, Slim, wants to stay in one place and start supporting the top.

9. Ann wants to start up the miner and cut through the fall.

10. Jimmy goes up to the fall and tries to move the rock. He keeps saying over and over again, "We gotta move the fall. We gotta get out of here." You should use timbers to support the top near Jimmy so he doesn't get hurt.

Question C

You and Slim convince Ann and Mac that you should stay in the safest place, support the top, and wait for rescue. You have managed to quiet Jimmy. He is sitting slumped against the rib, moaning and shaking. Jimmy looks at you as you tell him the group's decision, but he does not respond. You decide to put up extra timbers to support the top to make a safe place to wait. Which position, in Figure 3, would be the safest? (Choose only ONE unless directed to "Try again!")

11. Position A because it was bolted last.

12. Position B because there is more support for the top here than elsewhere.

13. Some of you should stay inby the new fall at position C while others go inby yesterday's fall at position D. This way you can hear rescue attempts from either direction.

14. Position E, because the newly installed cribs will support the roof.

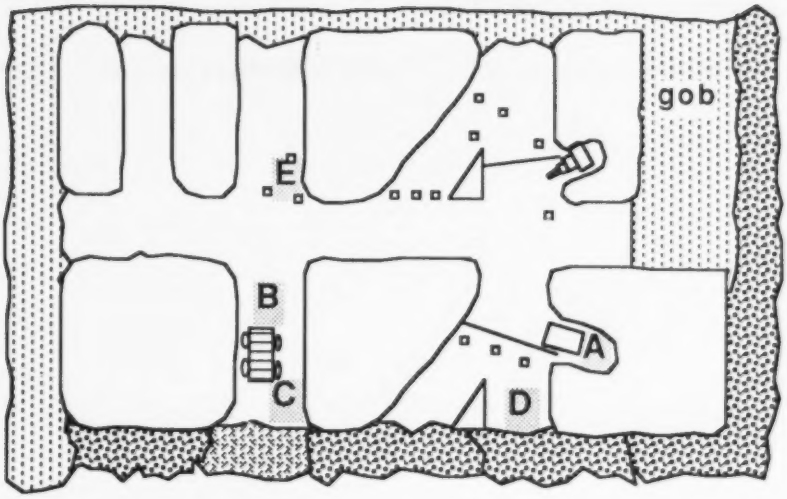

Figure 3: Possible positions of safety

Question D

After thinking about your options, you set additional roof supports and wait for rescue at position B. (See Figure 3.) What should you do while you wait? (Choose only ONE unless directed to "Try again!")

15. Send one or two people at a time to remove as much of the fall as they can while staying under supported top.

16. Sit quietly to conserve your air.

17. Stay together under the extra support you put up. Talk to each other, being sure to include Jimmy in the conversation.

18. Signal to the miners outby the fall by banging on a roof bolt with a timber.

Question E

When the fall first occured and trapped you and your buddies, the foreman yelled to you. You yelled back and said you and the others were OK. What should the foreman have done next? (Choose only ONE unless directed to "Try again!")

19. Gone to another section to get help.

20. Phoned outside and reported the roof fall.

21. Supported the roof near the fall.

22. Started to remove the rock to rescue the miners.

Question F

Immediately after the fall, the foreman called outside and reported the details and asked for assistance. He said the top looked bad. While he was at the phone, he also sent the beltman to another section to get help. What should the foreman have done next? (Choose only ONE unless directed to "Try again!")

23. Gone back to the fall area and waited for help to arrive.

24. Gone back to the fall and started removing rock from the intersection.

25. Gone back to the fall, gathered materials, talked to the trapped miners, and started supporting the roof outby the fall.

26. Gone to yesterday's fall to see if any of the miners were inby that fall.

27. Gone back to the fall, gathered roof support materials, talked with the trapped miners, and developed a plan.

Question G

While the foreman gathers roof support materials outby the fall, he yells to you that help is on the way. You yell back that you are all OK. You and the other miners are waiting at position B where you have set extra timbers around yourselves. (See Figure 3.) Now you hear and see a second fall on top of the first one. The fall extends about three feet further up crosscut 39 toward your position. You immediately yell to the foreman, but there is no response. What should you do now? (Choose only ONE unless directed to "Try again!")

28. Start digging your way out before it all comes down.

29. Go to yesterday's fall at position D. Yell and see if anyone can hear you through the fall.

30. Stay where you are, under roof support, at position B.

31. Leave position B. Move back to position E and get in between the cribs.

Question H

You have been trapped for 3 hours. You are waiting at position B with extra timbers set around yourselves. Jimmy has calmed down. Everyone is still feeling OK. You are all breathing comfortably. You hear miners outby the fall working to free you. The sound gets louder and you see a light shine through the top edge of the fall near the right rib. What should you do? (Choose only ONE unless directed to "Try again!")

32. Have one person go to the hole and check to see if it is possible to crawl through.

33. You and the other trapped miners should go to the fall and make the hole bigger from the inby side of the fall so that you can leave as soon as possible.

34. Pull the timbers around position B where you are waiting and start supporting the top just inby the hole through the fall.

35. Wait at position B until the rescuers have advanced all the way through the fall area and set supports inby the fall. Talk with the rescuers while you wait.

Question I

This exercise is based on an actual case. Fortunately, no one was injured, although the miners were trapped for several hours. The mine management and the miners should not have allowed this dangerous situation to develop. List all the unsafe mining practices and violations of state and federal laws that occurred in this problem. (Write on the blanks on the answer sheet.)

END OF PROBLEM

Scoring your performance

1. Count up the total number of responses you colored in that were marked "correct". Write this number in the first blank on the answer sheet.

2. Count the total number of incorrect responses you colored in. Subtract this number from 25. Write the difference in the second blank on the answer sheet.

3. Add the numbers on the first and second blanks. This is your score.

The best possible score of 35 results from selecting all the correct answers and no wrong answers. The worst possible score of zero results from selecting all the wrong answers and no correct answers.

Appendix B: Answer Sheet Blanks

These are the answer sheet blanks. Copies of these blank answer sheets may be duplicated in the normal fashion. However, the answers that are found within the brackets must be printed on these blank answer sheets in latent image ink. These answers are found in Appendix C. If you have the capability to print latent image ink, make copies of the blank answer sheets. Then make a mimeograph master of the latent image answers that appear in Appendix C. Then print the invisible latent image ink on the blank answer sheets, being careful to make sure all pages print and that the appropriate answers line up with the appropriate blanks. The Master Answer Sheet in the first part of this document shows all the latent image answers in their proper place.

Most companies and trainers prefer to purchase preprinted answer sheets. You may obtain copies of preprinted latent image answer sheets from the University of Kentucky or the National Mine Health and Safety Academy. The addresses and telephone numbers for these two agencies are listed in the footnote on page 3 of this document. Instructions for printing your own latent image answer sheets are also available from these two agencies.

The exercise may be administered in small groups or individually. Used individually, you will need one answer sheet for each person in your class. If you use the exercise in small groups, you will need one answer sheet for each 3 to 5 persons in your class. The answer sheets are consumable. You will need a new set for each class.

Special latent image marking pens are also needed by each person who marks an answer sheet. These may be obtained from the University of Kentucky IMMR office or the National Mine Health and Safety Academy. The addresses and telephone numbers for these two agencies are listed in the footnote on page 3 of this document. You may also purchase latent image marking pens and latent image ink supplies from A. B. Dick Company, 5700 West Touhy Avenue, Chicago, Illinois 60648, (312) 763-1900. The A. B. Dick Chicago Office can put you in touch with the local supplier for your area.

Answer Sheet for Roof Fall Entrapment Exercise

Use this answer sheet to mark your selections. Rub the special pen gently and smoothly between the brackets. Don't scrub the pen or the message may blur. Be sure to color in the entire message once you make a selection. Otherwise you may not get the information you need.

Question A (Select as MANY as you think are correct)

1. [ ]
2. [ ]
3. [ ]
4. [ ]
   [ ]
5. [ ]
6. [ ]
   [ ]

Question B (Choose only ONE unless directed to "Try again!")

7. [ ]
   [ ]
8. [ ]
   [ ]
9. [ ]
   [ ]
10. [ ]
    [ ]

Question C (Choose only ONE unless directed to "Try again!")

11. [ ]
    [ ]
12. [ ]
    [ ]

Question C (continued)

13. [ ]
    [ ]

14. [ ]
    [ ]

Question D (Choose only ONE unless directed to "Try again!")

15. [ ]
    [ ]

16. [ ]
    [ ]

17. [ ]
    [ ]

18. [ ]
    [ ]

Question E (Choose only ONE unless directed to "Try again!")

19. [ ]

20. [ ]
    [ ]

21. [ ]

22. [ ]
    [ ]

Question F (Choose only ONE unless directed to "Try again!")

23. [ ]

24. [ ]
    [ ]

25. [ ]

26. [ ]
    [ ]

Question F (continued)

27. [ ]
[ ]

Question G (Choose only ONE unless directed to "Try again!")

28. [ ]

29. [ ]
[ ]

30. [ ]

31. [ ]
[ ]

Question H (Choose only ONE unless directed to "Try again!")

32. [ ]
[ ]

33. [ ]
[ ]

34. [ ]
[ ]

35. [ ]
[ ]

Question I

List all the unsafe mining practices and violations of state and federal laws that occurred in this problem.

_____

_____

_____

_____

END OF PROBLEM

Finding your score

Number of "Correct"answers you colored in = (1) _____

25 minus number of incorrect answers you colored in = (2) _____

Add blanks one and two to get your total score = (3) _____

Highest possible score = 35

Lowest possible score = 0

TRAINEE'S QUESTIONNAIRE

1) name of exercise _____

2) your age _____ 3) your sex _____ M _____ F 4) years underground coal miner _____

5) your job title _____

Check all the areas in which you have special training, certification, and/or that you routinely perform.

	Special Training	Certification	Routinely Perform
6) Mine Foreman	_____	_____	_____
7) Mine Safety Committee	_____	_____	_____
8) Mine rescue	_____	_____	_____
9) CPR	_____	_____	_____
10) Advanced first aid	_____	_____	_____
11) EMT	_____	_____	_____
12) Advanced life support	_____	_____	_____
13) Other (describe) _____	_____	_____	_____

Think about the exercise you just finished. Circle the number which tells how much you agree or disagree with the following statements

	Definitely Yes			Definitely No
14) This problem could happen in real life.	4	3	2	1
15) This exercise will help me remember something important if I am ever in a similar situation.	4	3	2	1
16) I learned something new from the exercise.	4	3	2	1
17) The exercise took too long to complete.	4	3	2	1
18) I liked working the exercise.	4	3	2	1
19) The instructor's directions were clear.	4	3	2	1
20) The written directions in the exercise were easy to understand.	4	3	2	1
21) The diagrams, charts, and pictures were easy to understand.	4	3	2	1
22) The scoring procedures were easy to understand.	4	3	2	1
23) The exercise was easy to read.	4	3	2	1

If you have anything more to say about the exercise, please write on the back of this page. Thank you.

Appendix C: Latent Image Answers

These pages contain the latent image answers that must be printed in the blanks of the answer sheet in Appendix B. These answers are spaced and sequenced correctly so that they exactly match up with the appropriate blanks on the answer sheet blank.

Once the latent image ink answers have been printed on the answer sheet blanks, the special developing pen reveals the formerly invisible (latent image) printed message.

You may purchase preprinted answer sheets or you may prepare your own copies. To learn more about this option, and to determine how many answer sheets and special pens you will need, see the introductory section for Appendix B.

Correct! Everyone says that they are OK.

Correct! You yell to him and can barely hear him say that he will get you out.

You should not split up or leave this area now.

It would be dangerous to try to move the fall. Air is not a major concern at this time.

There are things you should be doing now.

Correct! The top appears to be good nearly all the way up to the E6-C39 intersection. It is still working near the fall.

The top over the fall is not supported and is still working. This would be very dangerous. Try again!

Correct! This should be done as soon as possible in the safest area. Do next question.

The power to the miner has been cut by the fall. Anyway, this could be dangerous. Try again!

You should try to calm Jimmy and keep him away from the fall area. Try again!

This area is inside an incomplete pillar. It is not safe. Try again!

Correct! This is the safest place because it is between the two most complete pillars. Do next question.

Position C is not safe. The incomplete pillars make this area unstable. Try again!

The split pillar on the left, and the cut pillar on the right, make this area unstable. Try again!

This is dangerous. The top is still working near the fall. Try again!

Air would not be a major concern in this large an area. There is something else you should be doing. Try again!

Correct! You need to stay under the extra support. The top is weak. Jimmy is upset. You should keep an eye on him. Do next question.

Pounding the top could possibly cause another fall. The top is weak. Anyway, the others know where you are. Try again!

There is something else he should have done first. Try again!

Correct! He should have immediately called for help and equipment, including first aid supplies. Do next question.

He should have done something else. Try again!

This is dangerous. He might have been killed and been of no help to the others. Try again!

There is something else he should have done. Try again!

This is dangerous. Try again!

This is risky. Try again!

The help he sent for will arrive at today's fall. Try again!

Correct! It is wise to plan, gather materials, talk to the trapped miners, and not try to support the bad top until help arrives. Do next question.

This is not safe. Try again!

This area is not safe. Anyway, help is on the way to position B. The foreman has told the others where you are. Try again!

Correct! Soon you hear rock being moved. Do next question.

This is dangerous. There is less pillar support at position E than at position B. Try again!

This is dangerous. Try again!

This is dangerous. Try again!

You should not remove these timbers. The falls may have made this area unstable. Try again!

Correct! You should stay at position B until the way out is made safe. It is important to talk with the rescuers while you wait. Do next question.